Claims

1. A process for the nonoxidative dehydrogenation of an alkylaromatic feed stream comprising passing the alkylaromatic feed stream through a radial reactor containing two or more nonoxidative dehydrogenation catalysts, wherein the nonoxidative dehydrogenation catalysts are arranged in vertically layered beds within the radial reactor, wherein the nonoxidative dehydrogenation catalysts comprise at least a first nonoxidative dehydrogenation catalyst and a second nonoxidative dehydrogenation catalyst, wherein the first and second nonoxidative dehydrogenation catalysts each have different operating or performance characteristics.

2. The catalyst of Claim 1 wherein the first nonoxidative dehydrogenation catalyst is placed in an inner, vertical layer within the radial reactor and wherein the second nonoxidative dehydrogenation catalyst is placed within a vertical layer that is a greater linear distance from a center of the radial reactor than is an outer edge of the inner vertical layer.

3. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has a higher selectivity than the other nonoxidative dehydrogenation catalyst.

4. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has a higher activity

than the other nonoxidative dehydrogenation catalyst.

5. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has both higher activity and selectivity than the other nonoxidative dehydrogenation catalyst.

6. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has improved stability at lower reaction pressures than does the other nonoxidative dehydrogenation catalyst.

7. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts produces a lower pressure drop than does the other nonoxidative dehydrogenation catalyst.

8. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has improved steam/oil stability at a lower reaction temperature than does the other nonoxidative dehydrogenation catalyst.

9. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has a longer effective catalyst life at reaction temperatures than does the other nonoxidative dehydrogenation catalyst.

10. The process of Claim 1 wherein one of the nonoxidative dehydrogenation catalysts has a different physical shape than does the other nonoxidative dehydrogenation catalyst.

11. The process of Claim 1 wherein one of the

nonoxidative dehydrogenation catalysts comprises from about 30 to about 90 weight percent of an iron compound calculated as Fe_2O_3, and about 1 to about 50 weight percent of an alkyl metal source calculated as an alkali metal oxide.

12. The process of Claim 11 wherein the nonoxidative dehydrogenation catalyst further comprise one or more promoters.

13. The process of Claim 1 wherein the nonoxidative dehydrogenation catalysts comprise a first, second and a third nonoxidative dehydrogenation catalysts, wherein at least one of these catalysts has different performance and/or operating characteristics than at least one of the other two catalysts.

14. The process of Claim 1 wherein the nonoxidative dehydrogenation catalysts comprise a first, second, third and fourth nonoxidative dehydrogenation catalysts, wherein at least one of these catalysts has different performance and/or operating characteristics than at least one of the other three catalysts.

15. The process of Claim 1 wherein the second nonoxidative dehydrogenation catalyst comprises about 30 to about 90 weight percent of an iron compound calculated as an Fe_2O_3, about 1 to about 50 weight percent of an alkali metal source calculated as an alkali metal oxide, and about 0.1 ppm to about 1000 ppm of a noble metal source selected from the group consisting of elemental noble metals, compounds

containing noble metals and combinations thereof, wherein all weight percents are based on the total weight of the catalyst.

16. The process of Claim 1 wherein the second nonoxidative dehydrogenation catalyst comprises from about 40 to about 90 weight percent iron oxide calculated as Fe_2O_3, from about 5 to about 50 weight percent of an alkali metal compound calculated as an alkali metal oxide, from about 1 ppm to about 100 ppm of a source of noble metal source selected from the group consisting of an elemental noble metals, compounds containing a noble metal and combinations thereof, from about 0.5 to about 10 weight percent of a molybdenum or tungsten compound, calculated as MoO_3 or WO_3, and from about 4 to about 30 weight percent of a cerium compound, calculated as CeO_2, wherein all weight percents are based on the total weight of the catalyst.

17. The process of Claim 1 wherein the second nonoxidative dehydrogenation catalyst comprises from about 40 to about 90 weight percent iron oxide calculated as Fe_2O_3, from about 5 to about 50 percent of a potassium compound calculated as potassium oxide, from about 0.1 ppm to about 20 ppm of a noble metal source selected from the group consisting of an elemental noble metal, compounds containing a noble metal and combinations thereof, from about 0.5 to about 10 weight percent of a molybdenum or tungsten compound calculated as MoO_3 or WO_3, from about 4 to about 30 weight

percent of a cerium compound calculated as CeO_2, from about 0.2 to about 10 weight percent of a calcium or magnesium compound calculated as an oxide, from about 100 ppm to about 2000 ppm of a chromium compound calculated as Cr_2O_3, and from about 10 ppm to about 1000 ppm of a source for titanium calculated as TiO_2, wherein all weight percents are based on the total weight of the catalyst.

18. The process of Claim 1 wherein the first nonoxidative dehydrogenation catalyst comprises about 5 to about 95 percent of the nonoxidative dehydrogenation catalysts contained within the radial reactor, wherein the percentage is based on the linear bed depth measurement of the catalysts within the reactor.

19. The process of Claim 1 wherein the first and second nonoxidative dehydrogenation catalysts are in intimate contact with each other within the radial reactor.

20. The process of Claim 1 wherein the alkylaromatic feed stream comprises ethylbenzene and steam.